Exploring the relationship between product-service system and profitability

Servitization intensity, service offerings and performance: some empirical evidence

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Over the last few decades there has been a significant change in the economic output structure worldwide and services are more and more dominating in the industrialized world (USA and Europe). Manufacturers strengthen their competitive position relying on service offerings, a process which has been termed "servitization" ("*more and more corporations throughout the world are adding value to their core corporate offerings through services*" - Vandermerwe and Rada, 1988).
The aim of this paper is to contribute to the investigation of the service paradox issue using quantitative data. The specific service offerings (typologies) will be evaluated as having an impact on the performance of the companies and then, the servitization intensity as affecting company profitability.
Empirical analysis is specifically performed on machinery manufacturing firms. Following an initial selection, the data on 10,995 companies was collected from the ORBIS database. Then the paper focuses on a dataset of 3,547 companies. The analyses performed consider the provenance of firms and distinguish between EU 15 versus BRIC countries.
On one hand, the findings reveal that a higher profitability increases the chance of servitizing while it is reduced for companies belonging to wider corporate groups with a higher number of subsidiary and parent companies. On the other hand, the number of services offered positively influence firm profitability. In a more detailed manner, the specific service typology "System and solution", that means the provision of a service to satisfy the need of the customer by linking its product offer with product or services of other companies, positively affect profitability. Finally, from a geographical perspective, two kinds of considerations can be made. First, European provenience seems to increase the odds of servitization. Moreover, developing (BRIC) companies offering services present a negative impact on company profitability, differently from advanced (EU) companies.

1. Introduction

The last few decades have been characterized by a significant change in the economic output structure. The service economy is dominating in the industrialized world (USA and Europe), accounting for over 70% of gross domestic product, and continues to grow (Schwab, 2016). Parallel to the development of the service industry in these countries, manufacturing firms are facing substantial challenges. In order to react to the intensified competition from emerging economies, especially from Asia and South America, and the globalization of markets as well as new customer needs, manufacturing firms themselves increasingly produce and offer services in addition (or in

substitution) to their traditional physical products. This is the phenomenon of "servitization of manufacturing" (Vandermerwe and Rada, 1988).

The term "servitization" was first introduced back in the late 1980s. The authors who used the concept of servitization, albeit ambiguously according to Alvizos and Angelis (2010, p. 2), were Vandermerwe and Rada in 1988 after interviewing senior executives of both service and manufacturing companies. They argued that servitization is a trend in which "*more and more corporations throughout the world are adding value to their core corporate offerings through services*" (Vandermerwe and Rada, 1988, p. 314). In furthering their argument, they defined servitization as a movement in which companies are increasingly bundling different offering elements such as "goods, services, support, self-service and knowledge", in order to provide "*fuller customer-focused market packages*" (Vandermerwe and Rada, 1988, p. 314).

Even though many definitions or similar concepts appeared in the literature after Vandermerwe and Rada introduced the term "servitization", they all have the propensity to broadly agree with the initial definition (Baines et al., 2009, p. 554). Our interest is particularly focused on the Operations management literature about servitization (Lightfoot et al., 2013).

A concept closely related to servitization is "going downstream", which was coined by Wise and Baumgartner (1999). They argued that typical manufacturing companies which strive to differentiate their products or face fierce competition and threats from large consolidated distribution channels should consider altering their business model, away from manufacturing. By moving "downstream", as they propose, manufacturers "*need to expand their definition of the value chain*" by incorporating in it their customers' value chain and "*shift their focus from operational excellence to customer allegiance*" by focusing on the most lucrative customer relationships (Wise and Baumgartner, 1999, p.134).

Concurrently, another concept called "servicing" was introduced in the literature by White et al. (1999). In their study on environmental implications, they defined "servicizing" as "*the emergence* […] *of product-based services which blur the distinction between manufacturing and traditional service sector activities*" (White et al., 1999, p. 2). In this case the product acts as a means to deliver functionality and the value created is measured by the ability to provide the functionality required by the end customer (White et al., 1999). Moreover, while challenging the dominance of manufacturing innovations, Howells (2000) argued that "servicization" is an innovative process by which a growing percentage of major manufacturing firms' added-value derives from selling

services. He stated that currently "service encapsulation" is leading within the innovation process in the manufacturing sector hence the role of services should not be viewed as merely supportive (Howells, 2000, p. 14).

In line with White et al. (1999) who argued that manufacturers deliver functionality through servitization, other authors shared a similar view. Lewis et al. (2004) and Slack (2005) defined servitization as "*any strategy that seeks to change the way in which product functionality is delivered to its markets*". The idea of providing product functionality has a specific value in the servitization literature. It serves as the link to another concept, the Product Service Systems (PSS), in which product functionality is classified as a specific type of product service offering (Tukker, 2004).

Mathieu (2001a) used the term servitization to describe the increasing range of service offerings by manufacturers, making a distinction, however, between services supporting the product and more advanced services which support the client. Finally, Neely (2008) introduced another definition which has been duplicated by Baines, including the innovation feature: "*the innovation of an organisation's capabilities and processes so that it can better create mutual value through a shift from selling products to selling Product-Service Systems (PSS)*".

More recently Brax and Visintin (2016) conducted a systematic literature review to propose a meta-model of servitization and offered a more pragmatic definition: "*servitization of manufacturing is conceptualized as a change process whereby a manufacturing company deliberately or in an emergent fashion introduces service elements in its business model*." (Brax and Visintin, 2016, p.18).

When competing through a servitization strategy, companies are moving along a "product-service continuum" (Oliva and Kallemberg, 2003; Neu and Brown, 2005; Gebauer, 2008). On one extreme lies the traditional manufacturer offering mainly products, while services are rarely proposed or are considered add-ons for their goods; the weight of services on total revenues is very low and limited. Whereas at the other extreme there is the service provider company whose principal offer are services and goods that can be added to satisfy customer needs. The weight of services on total revenues is preponderant. Nowadays more and more companies are moving along the product-service continuum toward the service provider. An example is Xerox's move from selling printers to gradually selling a "Document management service". In this way the company

provides the printer and all the maintenance services associated to keep the product correctly working. The customer simply uses the printer, pays according to the number of copies and does not have to worry about the printer being working properly. This is connected with the performance-based contracting (like "pay for performance" or "pay for results"; Selviaridis and Wynstra, 2015; Jiang et al., 2012).

There has been considerable discussion about if, and when, servitization is a profitable competitive strategy for manufacturers, and if relying on services indeed enhances their competitive position by (Lee et al., 2016). Thus far, manufacturing companies compete mainly through "product innovation and cost reduction" strategies (Baines and Lightfoot, 2013). Servitization offers a third option which does not necessarily mean substituting these strategies but rather supplementing the efforts of manufacturing companies to survive and compete successfully. Though the practice of servitization dates back to the 19th century (Schmenner, 2009; Baines and Lightfoot, 2013), adding services to the existing product offerings has proven to be an increasingly popular strategy over the last three decades.

Contrary to the many benefits expected, studies on the effect of services on the performance of manufacturing firms are controversial. In this sense, the literature on services (Gebauer et al., 2005) highlights the "service paradox" where substantial investment in extending the service business leads to increased service offerings and higher costs but does not generate the expected correspondingly higher returns. Meaning that more services don't automatically determine more revenues and profits.

We highlight two main motivations of this study. First, as recalled by Gebauer et al. (2012), more quantitative studies are required in order to understand the factors affecting the relationships between service strategies and performance. Furthermore, in this sense Brax and Visintin (2017) recall the need of quantitative studies which describe how advanced and/or complex the service business is. Kohtamaki et al. (2015), demonstrating that developing extended product-service offerings may yield performance benefits for manufacturing companies, suggests that it is not a matter of merely adding more services. In this paper we provide some more quantitative analyses to contribute on the topic focusing on a dataset of 3,547 companies in the machinery manufacturing industry.

The second motivation lies in the scarce attention of the literature on the service typologies as a factor to be investigated as affecting company performance (Visnjic Kastalli and Van Looy, 2013). In the paper, we specifically address the service typology as a driver of performance.

The paper aims at shedding some more light around the service paradox issue by addressing the following three research questions:

1. Which factors are affecting the servitization choice?
2. Is servitization intensity (number of service typologies offered) affecting company performance (profitability)?
3. Which service typology offerings have greater impact on company performance (profitability)?

Compared to previous quantitative studies, this paper explores possible service typologies which could gather more attention for (machinery) manufacturing companies, and possibly indicate more profitable service offerings to those companies which are willing to servitize.

The paper is structured as follows: the next section is dedicated to the literature review on service typologies and quantitative studies relating servitization to financial performance. Section two presents the research method and section three focuses on the results of the study. The last sections are dedicated to discussion and the conclusions of the research.

2. Literature review

2.1 Service offerings classifications

Researchers have developed an abundance of service classification schemes, where services are presented as typologies, business models or strategies. On the one hand, these classifications act as the foundation on which scholars draw their theories, while on the other hand practitioners formulate service strategies and business models. As such, some of the classifications belong to a more theoretical dimension while others are justified by empirical research.

In the first category of theoretical classifications, Frambach et al. (1997) dichotomised services according to the established relationship between the service provider and the customer into transaction-based and relationship-based. According to this concept, when the supplier offers services such as full maintenance contracts, the relationship with clients is more intimate and long lasting, which eventually leads to increased transactions in the future. Moreover, Mathieu (2001b) indicated that the content of the services serves as a classifying characteristic and identified three

types of services: customer service (e.g. free hotline for advice), product service (e.g. distribution or spare parts) and "service as a product" (e.g. standalone unrelated to the tangible offering). Nevertheless, this later classification is argued to be actually dichotomised between "*product-attached services versus product-independent services*" (Raddats and Kowalkowski, 2014, p. 22) with the first category containing customer and product services while the second includes services as a product.

As suggested by Mathieu (2001a) managers should abandon the idea of just offering a "one-fit-all" generic service portfolio, but rather they should consider engaging more proactively in classifying their service offerings to meet their clients' needs and sustain their competitive advantage. Hence, she proposed one of the most cited pragmatic classifications which distinguishes service offerings into "services that support the product" (SSP) and "services that support the client's actions" (SSC) (Mathieu, 2001a, p. 39), or as written by Visnjic et al. (2013, p. 6) the distinction between "product-oriented BM" and "customer-oriented BM". SSP refers to those services the provision of which ensures that the suppliers' specific product will operate properly and as promised to the customers (e.g. installation or repair). These services are the most common due to the fact that they are "less firm specific, less customised and less knowledge intensive" (Eggert et al., 2014, p. 27). Hence they are easily duplicated and they act mostly as an entry step into the service market. SSC on the other hand focus on continuously maximizing the client's overall performance, they are more complex, usually customised and they require that the supplier has a deep knowledge of the clients' businesses and processes. Taking into account that the SSP market is nearly saturated, manufacturers should move towards SSC as a means to sustain their competitive advantage. This category includes services such as operating customers' entire processes, optimization of processes through advisory or remote access and monitoring assets. An interesting addition to this classification comes from Cova and Salle (2008) who identified and classified services which support the client's network (SSN). This offering is a movement further downstream wherein services are provided not only to the end customer but also to every organization or institution involved or interested with the customer's business.

Gebauer et al. (2008) proposed a new set of service strategies based on different types of service offerings by manufacturing companies. These strategies are distinguished into after-sales service providers (ASP), customer support providers (CSP), development partners (DP) and outsourcing partners (OP) (Gebauer, 2008, p. 278). In the first strategy, firms offer basic services and

the focal objective is to provide a quick response in the case of product failure. While in the second strategy the objective is to prevent a potential product failure or disruption by offering advanced customised services. The third strategic option captures the common effort of DPs and their clients to co-develop products and systems "*within the pre-sales phase in order to possess a unique and hard-to imitate competitive position*" while the ultimate objective is to "*achieve outstanding customer performance*" (Gebauer et al., 2010, p. 202). The final strategic option assumes that the OPs operate customers' whole businesses or processes bearing the respective operating risk, thus necessitating OPs to have a solid knowledge of the clients' expected outcome.

A much easier and broader service classification comes from Baines and Lightfoot (2013): base, intermediate and advanced services. Base services are focused on product provision and the execution of production competence, for instance spare part provision, warranty or equipment provision. Intermediate services are about the use of production competencies for the maintenance of product condition, for instance helpdesk, training, maintenance, repairs or in-field services. Advanced services regard the use of production competencies for managing product performance, for instance customer support agreements, outcome contracts or risk and reward sharing contracts. The latter service category is receiving significant attention from researchers (Spring and Araujo, 2009; Baines and Lightfoot, 2013; Eggert et al., 2014; Bustinza et al., 2015) as it seems to guarantee a new revenue stream, a growth in profit and a closer relationship with customers.

Despite all the aforementioned classifications, the most pragmatic so far is provided by Neely (2008). After examining the business descriptions as provided by manufacturing firms in the OSIRIS database, he revealed how businesses reflect the breadth of offered activities in their everyday language. The 12 well-known categories developed by Neely (2008, p. 108) will serve as a basis for the current research. Table 1 provides the list and a brief description for each service typology.

Service Typology	*Description*
Design and Development Services	Customizing the design and development of the product to meet the customer needs.
Systems and Solutions	Satisfying the need of the customer by linking its product offer with product or services of other companies.
Retail and Distribution Services	Offering the service of promoting and distributing the product to the end customer.
Maintenance and Support Services	Offering the support to solve potential operational problems, spare parts ect.
Installation and Implementation Services	Installing and testing its products and eventually training the customer's employees.
Financial Services	Offering ways of financing the acquisition of the product
Property and Real Estate	Offering the service of managing property, equipment and other assets.
Consulting Services	Sharing his practical experience in the field to assist the customer.
Outsourcing and Operating Services	Offering the service of transferring portions of work to outside suppliers.
Procurement Services	Managing the process of preparation and processing of acquisition of products or services.

Leasing Services	Allowing specific way of financing the acquisition of the product through a leasing contract.
Transportation and Trucking Services	Providing delivery, transport and related logistic services.

Table 1: Service typology classification adopted in the research

The operationalization of service provision (or service categories) has a great variance in the literature. Homburg et al. (2002) and later Gebauer (2008), used a multidimensional concept of service strategy, including measures of service differentiation and different aspects of service offerings. Neely (2008) simplified this by measuring the number of services offered by manufacturing companies linking them to the extent of their service level development. Suarez et al. (2008) and Valtakoski (2011) measured the share of revenues generated by services. However, it is important to differentiate between different types of services (as noted by Fang et al., 2008; Valtakoski, 2011), even if it is not easy to relate them to a firm's performance. Previous studies simplified the measurement of service provision, and, as addressed by Gebauer et al. (2012), this may lead to erroneous conclusions. As our main aim is to investigate the relationship between service typology offerings and financial performance, it is crucial to define a wide set of service categories.

2.2 Servitization strategy and firm performance – Quantitative studies

A critical issue of research on servitization in manufacturing regards the understanding of the impact of servitization strategies on firm's performance. Even if such a transition has been implicitly considered beneficial, studies discussing the effect of services on manufacturing firms' performance are contentious. Gebauer et al. (2005) highlighted the "service paradox" where substantial investment in extending the service business leads to increased service offerings and higher costs but does not generate the expected correspondingly higher returns. Gebauer et al. (2005) argue that the ''service paradox'' has both an organizational and behavioural dimension which determines that managers are often unprepared to deal with its complexity.

A large body of empirical research has found a positive effect of servitization on firm profitability whereas other evidence has failed to discover such a relationship. In order to better organize the literature on the topic we provide here some elements of our interest of previous quantitative studies conducted in the last decade aiming at investigating the relationships between servitization and performance. The rationale for the inclusion of the research in this review was the consideration of a measure of servitization (or services in manufacturing) and, when possible, a measure of company performance. We restricted the selection to only quantitative studies based on survey or

database, but with no specific country location or sector. Table 2 presents a list of research useful for our purposes and a brief synthesis of the characteristics of the analyses with the variables used. Their main findings will be discussed hereafter.

Evidence indicates a mixed effect of servitization (or service integration) and profitability. Neely (2008) empirically validated that manufacturing firms applying a servitization strategy achieve higher revenues but might also obtain lower profit because higher labour costs and working capital are required. Furthermore, a recent study by Visnjic Kastalli and Van Looy (2013) looking at 44 subsidiaries of a multinational firm of capital goods for the period 2001-2007, found that the effect of service sales on profit margin is curvilinear, whereas the effect on product sales is positive. In particular, they found that initial increments of service sales had a positive impact on the subsidiary's performance, but this effect gradually decreased with the growth of service sales and then increased again once service sales became large.

Fang et al. (2008) found that a positive effect from servitization strategy takes place only after achieving a percentage of service portion from the total revenue of around 20-30%. They confirm that when the service ratio is above that level, the positive effects of service transition outweigh the negative effects, such as a loss of strategic focus and internal conflict. According to this study the overall pattern of the impact of services on performance is U-shaped.

Lay et al. (2010) tried to understand the extent to which service infusion has affected manufacturing industries and factors influencing service infusion. They first revealed a general low level of revenues from sales in the sample. Furthermore, they highlighted that the most significant determinant of service sales is the breadth of services offered, even if the characteristics of the type of products sold are important.

Neely et al. (2011) provided an update to an earlier study (Neely, 2008) covering the global trends in the servitization of manufacturing over a period of time. In 2011 as in 2007, the United States was the country with the highest level of servitization, although they noticed a slight decrease in servitization. The opposite trend has been recognized in China, with a notable shift toward servitization. The paper provide some more evidence on the servitization paradox, they noticed both successful and unsuccessful servitized firms.

Dachs et al. (2013) firstly confirm Lay et al. (2010) result according to which service revenues of manufacturing firms is still relatively low compared to the sales from physical products. Then, focusing on European countries, the findings did not highlight significant National differences in

explaining the degree of servitisation. Finally, the paper discovers a U-shaped relationship between firm size and servitisation, with the latter also positively related to product complexity and the propensity to product innovation.

Bikfalvi et al. (2013), studying the impact of servitization on networking in manufacturing industries, discovered that servitization is positively linked with increasing service networking activities of manufacturing companies. For our purposes it is interesting to notice that the paper also found that service offerings are linked to the likelihood of service cooperation but not to service sales.

Suarez et al. (2013), in analysing the performance of 464 US software firms from 1990 to 2006, also found a U-shaped relationship between service revenue and profit margin. They showed that a low level of service offerings initially erodes firm profitability; however, when the service revenue reaches the majority of firm revenue, the service offerings begin to have a positive impact on firm profitability.

In line with Fang et al. (2008), Kohtamäki et al. (2013) demonstrated that the positive effect of emphasizing service offerings on sales growth is significant only at moderate to high levels of services. Later, Kohtamaki et al. (2015), even if focussed on the Finnish market, demonstrated that service orientation is a fundamental mediator for the relationship between service offerings, revenues, and profits. Then the research provides evidence on the fact that both service offerings and service orientation are important when manufacturing companies decide to servitize.

More recently, Visnjic et al. (2016) studied servitization, as service business model innovation, trying to understand its relationship with product innovation and their impact on performance. It is curious to notice that the paper provides evidence on the fact that increasing service breadth (measured in number of services offered) has negative effect on profit performance, whereas increasing service depth (measured in completeness of service offering) results in higher margins and an increase in market value.

Kwak and Kim (2016) analysed Korean companies to observe the relationship between service integration and manufacturing firms' profitability in order to identify profitable services. A crucial finding was that the relationship between service integration and profitability has an inverted U-shape. This study is the first, and only, considering the impact of the service typology offered on firm profitability. Based on a self-classification of services into eight categories, the

evidence suggests that process operation outsourcing (i.e. operation of products on behalf of customers in or near the customers' location) and technical consulting (i.e. providing customer-specific solutions or solve critical technical problems that contribute to improving customers' productivity and optimizing the process design in manufacturing) significantly contribute to firm profitability.

Among the other research, it is notable to remember that Homburg et al. (2003), measuring the number of services offered and the emphasis on services, found that corporate culture and human resource management mediate the positive relationship between a service-oriented strategy and profitability. Later, Gebauer and Fleisch (2007) showed that increasing the share of service revenue has a positive impact on firms' return on sales (ROS). Elaborating on this view, Gebauer (2007) suggested that a "customer support service" strategy, which consists of services offered in the primary and adjacent customer activity chains, also has a positive impact on ROS through a sophisticated alignment with organizational design strategy.

At this current level of knowledge, the service paradox is far from being solved. Most of the above-mentioned studies reveal a positive, though nonlinear, relationship between an increasing level of service offering and a company's performance. Some studies sustain that empirical research on servitization and service integration is still at an early stage (Eggert et al., 2011; Jacob and Ulaga, 2008) and that further research is required to better understand the financial impact (Gebauer et al., 2012). Positioning in such stream of literature, the contribution of this work is to understand if any particular service typology can affect company's performance. Compared to previous research, we specifically look at any relationship between service typology and company's performance aiming at suggesting which type of service better contribute to the profitability of the company within the machinery manufacturing sector.

Article	*Data Source*	*Quantitative data*						*Measurement of "Performance" variable/s*	*Other variables/constructs considered*
		Sector/Code	*Nr. of countries represented*	*Company size*	*Initial sample size (nr. of companies)*	*Usable/Final sample size (nr. of*	*Year/s considered*		
Neely (2008)	Database (OSIRIS)	Manufacturing (US SIC codes 10-39), listed	25 (excluding countries with less than 60 firms)	> 100 employees	12.521	10.634	2007	Profit Margin	Extent of servitization
Fang et al. (2008)	Database (COMPUSTAT)	Manufacturing (US SIC codes 28-39), listed	1 (US)	n.d.	n.d.	477	1990-2005 (16 years)	Tobin Q (as firm value)	Service ratio, Service relatedness, Firm resource slack, Firm market share, Industry measures (growth, turbolence, competition, advertising intensity), Firm size, Firm Return on Assets (ROA), Growth in services, GDP growth
Lay et al. (2010)	Survey (European Manufacturing Survey)	Manufacturing (NACE Rev. 1.1. 15-37)	8 (AU, SW, DE, FR, CR, NL, SL and ES)	> 20 employees	3.376	1.976	2006-2007	NO	Number of service areas, Rank of services as competitive factors, Producer of finished goods (batch size, product development), Share of turnover with new products
Neely et al. (2011)	Database (OSIRIS)	Manufacturing (US SIC codes 10-39), listed	27	> 100 employees	13.259	12.331	2009	Firm Profitability Market Capitalization	Prior financial performance, Firm size
			27		14.974	13.775	2011		
Dachs et al. (2013)	Survey (European Manufacturing Survey)	Manufacturing	10 (AU, HR, DK, FI, FR, DE, NL, SI, ES and CH)	> 20 employees	n.d.	3.693	2008	NO	Servitization intensity, Innovativeness of the firm, Product complexity, Firm size
Bikfalvi et al. (2013)	Survey (European Manufacturing Survey)	Manufacturing (NACE 15 to 37)	6 (AU, CR, DE, ES, CH and SLO)	> 20 employees	1.904	1.904	2006-2007	Growth rate (Turnover)	Servitization, Complexity, Export quota, Production depth, Capacity utilization, Firm size, Country, Industry
Suarez et al. (2013)	Database (COMPUSTAT and MERGENT)	Software Industry (SIC code 7372)	1 (US)	n.d.	n.d.	2,469-2,880	1990-2006	Operating margin Return on Assets (ROA) Return on Equity (ROE)	% of total sales from services, sales growth, market share, number of employees, sales of the industry
Kohtamaki et al. (2013)	Survey (web-based questionnaire)	Manufacturing (US SIC code 28)	1 (FI)	> 20 employees	404	91	2010	Revenue growth	Service offering, Network capabilities, Number of patents, Breadth of customer base, Product performance, Slack resources
Kohtamaki et al. (2015)	Survey (web-based questionnaire)	Manufacturing (US SIC code 28)	1 (FI)	> 20 employees	n.d.	115	2010	Sales performance Profit Performance	Company size, Customer heterolgeneity, Product Business model, Service offerings, Service orientation
Visnjic et al. (2016)	Database (OSIRIS and Datastream)	Manufacturing (US SIC codes 10-39)	Developed Countries (no specification)	> 100 employees	1.995	133	1999-2009	Sales growth EBIT Margin Tobin Q	Service investment, No. of services, Service completeness, R&D/Sales, Firm size (log of employees)
Kwak and Kim (2016)	Survey	Manufacturing (Machinery and Equipment)	1 (Korea)	n.d.	340	202	2011	Return on Sales (ROS)	Service offerings (eight industrial services), Service Integration Intensity, Product R&D intensity, Market Share, Firm age and size, Industry control variables (domestic industry growth and export market growth)

Table 2: Previous quantitative studies on servitization and performance

3. Research design

In line with the empirical research of Neely (2008), we approached our research questions using database elaborations. The ORBIS database (by Bureau van Dijk) was used to extract data. This research is focused on the "machinery manufacturing" sector where servitization has been implemented for a long time. Dachs et al. (2013) reports how "machinery & equipment" and "fabricated metal products" are among the most servitized sectors. This is further confirmed by Lay (2013), who revealed an average of 17.1% of service sales directly and indirectly invoiced by Machinery manufacturers against an average of 13.0% on a sample of manufacturing companies. We expect to find an higher level of servitization propensity in such sector, this is the reason why we focused on NAICS codes 333.

The primary data used in the study was downloaded from the database in April 2014 and a multistep process was employed in order to filter data and achieve the final dataset.

Initially, companies with an "active status" were considered, hence we discarded companies which were bankrupt or with an unknown status. Then we selected only the companies which had

filled in the "overview information" field for their activities. The "overview information" field contains comprehensive information about the activities of the companies and is comprised of fields such as "Full overview", "Trade description", "Main products and services", "Primary business line" and "Secondary business line". These fields were requested upon information availability but it was not a necessary condition for companies to provide all of them in the sample. The next step was the selection of the specific industries we were interested in. The NAICS codes 333, corresponding to machinery manufacturing was selected. Then we only included companies from EU15 and BRIC countries as these areas constituted our main interest. A further filter related to size: companies with more than 100 employees, in line with Neely (2008), Visnjic et al. (2012), Dachs et al. (2013) and Visnjic et al. (2013), were selected. The dataset comprises 3,547 companies.

To analyse the breadth of the firms' service offering (servitization intensity), a classification scheme was necessary that identified the various services that a manufacturing firm might offer. The 12 service types suggested by Neely (2008) were applied. An automated and then human control on the classification of services was applied. A first step included the distinction between servitizing and non servitizing companies using a code developed in Excel with Visual Basic for Applications (VBA). When performed, the VBA code automatically searches for specific strings denoting the presence of services in the cell field "company information". Every company offering at least one service was further processed. The descriptions contained in the database of the servitizing companies were manually scrutinized and the services offered were classified in the appropriate category of the twelve applied. This manual categorization helped to identify any misclassification caused by the automated string search VBA code. Thus, *servitization intensity/breadth* was defined as the number of such service types that the firm offered.

Performance measure was defined with the *Net Operating Income* (NOI). We first employed Profit margin as a measure of profitability. It is the most commonly used measure of performance (Neely, 2008; Gebauer, 2008; Gebauer et al., 2010).

Other variables we considered in the analysis are: *firm size*, *BRIC* and *complexity*. Firm size was measured as the number of employees, coherently with previous research. A dummy variable was used to measure the belonging of the company to a BRIC country. Finally, complexity was measured as the number of legal entities to which the company belongs. The latter was provided by the database.

All data analysis provided in this article was performed by R (R Development Core Team, 2008; Lê, Josse and Husson, 2008).

4. Data analysis

In order to answer the research questions introduced in section 1, we propose a generalized linear model (*glm1*) and two multiple regression models (*lm1* and *lm2*).

The generalized linear model we propose is the output of a logistic regression aiming at classifying firms in terms of their odds of servitizing. The dummy variable *d_serv* is 0 for not servitizing companies and 1 for servitizing firms while $\frac{\pi}{1-\pi}$ is the probability that *d_serv* equals 1. The three explanatory variables are: *firms* (the number of subsidiary and parent companies composing the corporate group which the firm analyzed belongs to), *d_reg* (a dummy variable which is 0 for EU15 firms and 1 for BRIC ones) and *profitmarg* which is the profit margin of the firm, the ratio between *net income* and *revenues*.

$$\log_e\left(\frac{\pi}{1-\pi}\right) = \beta_0 + \beta_1 d\_reg + \beta_2 profitmarg + \beta_3 firms$$

This model was compared with an extended version including also the firm size (in terms of employees) as an explanatory variable. Because the two models are nested (the first one is a subset of the second one), an anova chi-squared test can be used to compare them. The non-significant chi-square value (p=0.21) suggests that the reduced model, with three predictors, fits as well as the extended one, with a predictor more. Table 3 summarizes the results for *glm1*.

	glm1
(Intercept)	1.286 (0.08448) ***
d_reg	-0.258 (0.07988) **
profitmarg	0.016 (0.005531) **
firms	-0.000093 (0.00001217) ***

Table 3

The odds of servitizing are increased by a higher profitability and are reduced for BRIC firms and for firms belonging to wider corporate groups with a higher number of subsidiary and parent companies. The first multiple regression model (*lm1*) considers the potential (functional) relationship between *Net Operating Income* (*NOI*) and *servitization intensity* (the number of service categories provided by firms identified by the variable *services*), controlling for *firm size* (*firms*) and *geographic location*. The model proposed is:

$$NOI = \beta_0 + \beta_1 d\_reg + \beta_2 services + \beta_3 employees + \beta_4 firms + u$$

In order to determine all the following OLS regression lines we used the data related to the 3,547 firms in our sample. The estimated model for *lm1* is:

$$\widehat{NOI} = 1496.8 - 5186.29 d\_reg + 889.57 services + 10.29 employees - 0.29 firms$$

The only non-significant coefficient is β_4 (p-value=0.21) while β_1, β_2 and β_3 are significant (respectively, p-value is lower than 0.001 for β_1 and β_3 and lower than 0.05 for β_2). They seem consistent, indicating that the bigger firms' size, the higher Net Operating Income (which is necessary in order to control for *firm size*). Moreover, *m1* shows that *Net Operating Income* is higher for EU15 firms than for BRIC ones (β_1 is negative) and *servitization intensity* could be considered a driver for better financial performance.

The second multiple regression model (*lm2*) tries to explain what is the effect of different servitization choices on the profitability of firms. Also this model allows for *firm size* and *geographic location*.

$$NOI = \delta_0 + \delta_1 d\_reg + \delta_2 d\_DD + \delta_3 d\_II + \delta_4 MS + \delta_5 SS + \delta_6 RD + \delta_7 employees + \delta_8 firms + u$$

lm2 considers five dummy variables more, which indicate the most selected servitization choices in our sample, in terms of service categories implemented: *Design and Development* (*d_DD*), *Installation and Implementation* (*d_II*), *Maintenance and Support* (*d_MS*), *Systems and Solutions* (*d_SS*) and *Retail and Distribution* (*d_RD*). All the variables are dummy and are equal to 1 when the service category is implemented. The estimated model for *lm2* follows.

$$\widehat{NOI} = 1582.93 - 5006.43d\_reg + -714.75d\_DD + 679.77d\_II + 953.25d\_MS + 3611.54d\_SS + 2270.25d\_RD + 10.28employees - 0.29firms$$

Firm size and *geographic location* coefficients continue to be significant with the same signs while the only service category presenting a significant (and positive) coefficient is *Systems and Solutions* (*d_SS*).

Table 4 summarizes the results obtained for *lm1* and *lm2*.

	lm1	*lm2*
(Intercept)	1496.801 (1702.3722)	1582.931 (1789.4689)
employees	10.293 (0.1139) ***	10.284 (0.1140) ***
d_reg	-5186.288 (1526.6872) ***	-5006.425 (1554.1781) **
firms	-0.286 (0.2315)	-0.291 (0.2329)
services	889.572 (444.1199) *	
d_DD		-714.750 (1475.2753)
d_II		679.771 (1857.2262)
d_MS		953.246 (1740.8676)
d_SS		3611.539 (1826.7383) *
d_RD		2270.251 (1934.7040)
R-squared	0.7084	0.7086
Adj. R-squared	0.7081	0.708
F	2151 on 4 and 3542 DF ***	1075 on 8 and 3538 DF ***

Table 4

5. Discussion and Conclusions

5.1 Discussion

In order to answer the first research question, a binary response model was introduced aiming at analysing the odds of servitizing with reference to EU and BRIC firms. The results show that a higher profitability increases the chance of servitizing while it is reduced for companies belonging to wider corporate groups with a higher number of subsidiary and parent companies. Therefore, the odds of servitizing seems associated to higher profitability and smaller corporate groups. The third relationship is undoubtedly weaker, although significant (the estimated coefficient is just -

0.000093 and the standard error is 0.00001217), and consistent. Actually, belonging to wider corporate groups could mean that other subsidiary and parent companies were started/acquired specifically to offer some services. It can be seen as a group-level servitization based on horizontal integration policies. The element of novelty provided here is that companies with higher profitability are also offering more services.

Based on our evidence, we can claim that the number of services offered positively impact on firm profitability. In the literature we can find divergent results on the topic. Homburg et al. (2003) found a positive relationship between the number of services offered and firm profitability, measured with ROS. Partially in line with the latter is the evidence of Neely (2008). He found that the number of services has a positive effect on revenues but negative on net profit rate. Our evidence contributes in the first stream of research.

What is furthermore proposed here, in the third model, is that some service typology has a particular impact on profitability. Based on the analysis of our sample of companies in the machinery manufacturing sector, the type of service "System and solution" is the only having a positive, and statistically significant, relationship with the firm profitability. As recalled in the introduction, according to our knowledge, the literature presents only one contribution focussed on the relationship between the breath of service offerings (i.e. number of services offered) and firm performance from Kwak and Kim (2016). Focussed on the machinery and equipment sector in Korea, the research found that process operation outsourcing (i.e. operation of products on behalf of customers in or near the customers' location) and technical consulting (i.e. providing customer-specific solutions or solve critical technical problems that contribute to improving customers' productivity and optimizing the process design in manufacturing) significantly contribute to firm profitability. We believe that our result is highly coherent with Kwak and Kim (2016) as "System and solution" service typology clearly recalls the technical consulting activity category. Both service typologies are about satisfying the customer and optimizing its productivity by providing a complete solution.

Going back to Baines and Lightfoot's (2013) classification among base, intermediate and advanced services, some literature show empirical results demonstrating the benefits in revenues and profit of advanced services (Eggert et al., 2014; Bustinza et al., 2015). We argue that among our 12 service typologies only a few are advanced, and this could explain the non-significance of some

results in the model *lm2*. Another point to be taken into consideration, strictly related to the previous one, is about the nature of the service typology offered. Some of the 12 services considered are probably "guaranteed" and related to the offer that the manufacturer "has" to realize as a minimum. In this sense, such services do not represent a source of competitive advantage and, consequently, profitability.

Finally, from a geographical perspective, two kinds of considerations can be made. On one hand, European provenience seems to increase the odds of servitization (this is another result of the first binary response model we proposed). On the other hand, developing (BRIC) companies offering services present a negative impact on company profitability, differently from advanced (EU) companies. Previous literature has mainly been focussed on the level of servitization among countries more than including also firm profitability, as we have done. Neely (2008) noticed that there are more servitizing manufacturing firms in highly developed economies than in industrialising economies (e.g. US versus China). Later Neely et al. (2011) registered a slight decrease in servitization in US companies and that the biggest and most notable shift happened in China, where serviting manufacturing firms increased from less than 1% of the sample in 2007 to 19.33% in 2011. Finally, Neely (2013) registered higher levels of servitization in Germany than in the BRIC countries, but lower than other EU countries like the UK and the US. All this data confirms that the BRIC countries, especially China, are making significant efforts to boost their service economies.

5.2 Conclusions

Moving from the debate on the service paradox, our study sustain the stream of literature supporting the servitization strategy as a driver of financial performance.

As reported by Gebauer et al. (2016), one reason for the service paradox is that companies underestimate the complexity of the service business. Service demand can be very unpredictable. Basic services associated with the installed base are highly unpredictable, resulting in their demand being very sporadic. This makes the management of the service resources very complex. More advanced services become increasingly heterogeneous. Each of these services is highly customized, making it difficult to standardize the service elements and to control the cost of their delivery.

We provided evidence to answer our research questions. We could interpret the choice of specific service typology as coming from differential competencies rather than managerial attitudes (fashion effects). An important element of our study is that partially such choice is driven by financial performance. Strategic or marketing issues are probably real drivers of the choice of service typologies (in particular advanced services according to Bustinza et al., 2015).

Some limitations characterise the research. First, the service typology classification chosen (Neely, 2008) can be criticized. As any classification, it is an attempt to represent the possible variety of services to be offered by a manufacturing company. Embracing this pragmatic classification, we lost some service features as the strength of relationship between the company and the customer and the specific way the service can be provided. For instance, the maintenance service can be provided in different ways and with different technologies.

In both the linear regression models proposed, aiming at studying the impact of servitization intensity and different servitization choices on the profitability of firms, the explained variable used is the Net Operating Income (NOI). This measure could be considered misleading when performing a profitability analysis and undoubtedly it is because of the absence of a standardization process allowing for firm size. Certainly, the use of a profitability ratio (ROE, ROI, ROA, …) could have been more adequate and precise; this is the reason why, unable to insert these kind of measures as explained variable, we inserted in both the models a regressor more (employees) which is typically considered a measure for firms' size.

Therefore, future research could be interested in more deeply analysing this aspect, searching for the reason why groups of companies decide to follow some specific patterns in offering given service typologies. Another possible stream of future research can be the extension of the study in a longitudinal way, aiming at analysing performance data and linking it to the servitization choices of the companies. Such a study could highlight a possible delay between the introduction of a service offer and the attainment of significant performance results. Other forms of performance, different from the mere financial one, can be also investigated. Is there any impact on environmental or social performance due to a servitization strategy choice?

Finally we recognize that this research lost and did not consider the "how" such services are delivered. The proximity with the customer and the technology employed are some of the elements that can change the way the service is provided. This could represent the real potential value added of servitization (Baines et al., 2016). Furthermore, as recalled by Visnjic et al. (2016), the decision

to servitize cannot merely be considered a dichotomous, “yes-or-no” choice. Understanding the “how” a service is delivered can better help in the positioning of the company within the degree of servitization spectrum instead of the dichotomy “yes-or-no”.

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